

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

ERT3046 – MACHINE VISION
(RE)

20 OCTOBER 2016
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTION TO STUDENT

1. This Question Paper consists of 5 pages with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

a) Image enhancement approaches fall into two broad categories.

(i) What are the two categories?

[3 marks]

(ii) Describe each of them.

[5 marks]

b) An image with intensities in the range $[0,1]$ has the Probability Distribution Function (PDF) $P_r(r)$ shown in Figure Q1(a). It transforms the intensity levels of the image so that they have the specified distribution as shown Figure Q1(b). Find the transformation in terms of r and z .

[12 marks]

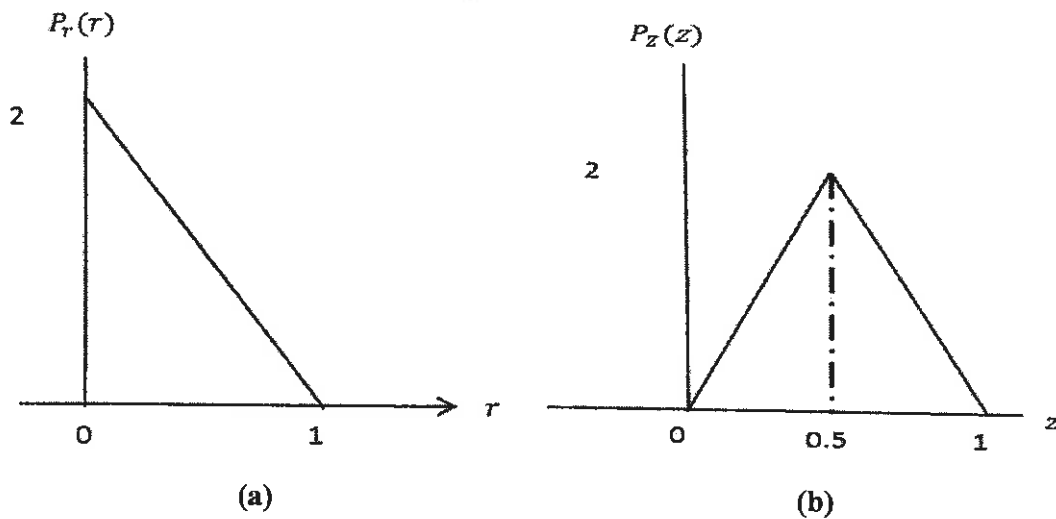


Figure Q1

c) With reference to Figure Q1-1, sketch the set $(A \cap B) \cup (A \cup B)^c$.

[5 marks]

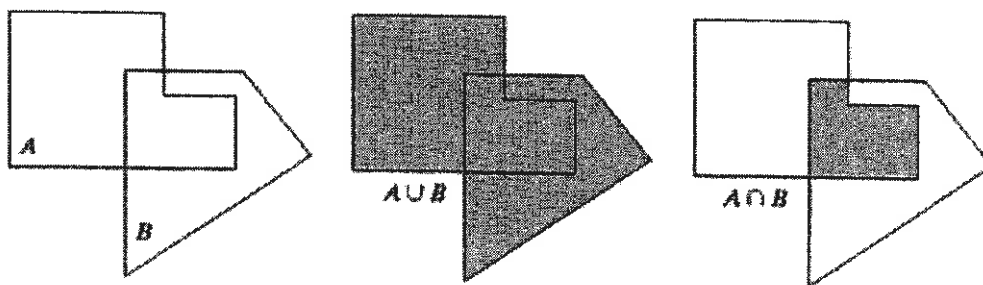


Figure Q1-1

Continued...

QUESTION 2

- a) Consider the 2-bit image of size 5 x 5 as shown in Figure Q2-1, compute the average value of the image using average intensity formula. [8 marks]

0	0	1	1	2
1	2	3	0	1
3	3	2	2	0
2	3	1	0	0
1	1	3	2	2

Figure Q2-1

- b) With reference to Figure Q2-2, the closing of binary image A by structure element S is denoted by $A \bullet S$ and the opening of binary image A by structure element S is denoted by $A \circ S$.

i) Illustrate the result of $A \bullet S$. [6 marks]

ii) Illustrate the result of $A \circ S$. [6 marks]

1	1	1	1	1	1	1	
			1	1	1	1	
			1	1	1	1	
		1	1	1	1	1	
			1	1	1	1	
		1	1				

1	1	1
1	1	1
1	1	1

Binary image, A							
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Structure Element, S		
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Figure Q2-2

- c) What are the limitations of histogram-based methods? Name five limitations. [5 marks]

Continued...

QUESTION 3

- a) Skeletonization is an important step for fingerprint recognition. Figure Q3(b) shows the pixel intensities in a 5x5 block which is taken from the binary fingerprint image in Figure Q3(a) (Ridge = value 1 pixel while Valley = value 0 pixel). Apply an 8-neighbourhood skeletonization algorithm to find the skeleton of the portion of fingerprint pattern inside the shaded 3x3 region of Figure Q3(b) assuming the pixels outside the shaded region remain unchanged. Illustrate the results of each step clearly. [12 marks]

**Figure Q3(a)**

0	1	0	1	0
1	0	1	0	0
0	1	0	1	0
1	1	0	1	1
1	0	1	0	1

Figure Q3(b)

- b) Describe "Iterative Thresholding" and the process required to implement it. [8 marks]
- c) Refer to Hough Transform, develop a procedure to obtain the normal representation of a line from its slope-intercept form, $y = ax + b$. [5 marks]

Continued...

QUESTION 4

- a) What are the two approaches to define texture? [5 marks]
- b) Table Q4-1 shows three (3) classes which are classified by their extracted features. Determine to which class M is classified into by using 5-nearest neighbour class. (use Euclidean distance as the distance metric) [10 marks]

Table Q4-1

Class X			Class Y		
Axis	x-axis	y-axis	Axis	x-axis	y-axis
point1	0.55	0.39	point1	0.35	0.29
point2	0.69	0.33	point2	0.37	0.23
point3	0.64	0.27	point3	0.39	0.09

Class Z			Class M		
Axis	x-axis	y-axis	Axis	x-axis	y-axis
point1	0.35	0.57	point	0.44	0.47
point2	0.32	0.46			
point3	0.27	0.4			

- c) Table Q4-2 shows a confusion matrix for a character recognition problem attempting to classify characters from 'A' to 'F'. There are 600 feature vectors in total to represent 600 alphabets. 'R' indicates 'reject' class. From the confusion matrix,
- (i) Calculate the error rates for all the inputs. [6 marks]
- (ii) Which input alphabet produces the least classification error? [2 marks]
- (iii) Compute the reject rate for the classifier. [2 marks]

Table Q4-2

	'A'	'B'	'C'	'D'	'E'	'F'	'R'
'A'	97	1	0	0	1	0	1
'B'	0	95	0	3	2	0	0
'C'	0	2	93	4	0	1	1
'D'	1	0	0	98	1	0	0
'E'	0	0	0	0	97	0	0
'F'	1	0	1	0	1	98	1

End of Paper